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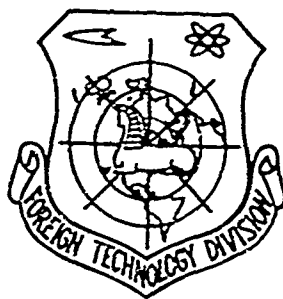
## FOREIGN TECHNOLOGY DIVISION



MORE POWERFUL THAN THE HYPERBOLOID

by

O. Andreyev



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ABSTRACT : Many pre-World War II Soviet publications carried articles on the so-called "death rays." More often than not, these articles, based largely on non-Soviet data, were pure science fiction. The few serious articles referred to deadly weapons using heat rays. The concept of weaponry changed drastically with the advent of lasers, which emit stimulated rather than thermal radiation. According to the article, the idea of using lasers for military purposes was first conceived in the United States, in 1961. Soviet lasers, it is stated, are being used only for the advancement of science and technology for peaceful purposes although the writer adds, "Of course, almost any scientific achievement may be used for military purposes." Mention is made of the use of lasers in multichannel communication systems, ranging of planetary surfaces, metallurgy, plasma diagnostics, biology, medicine, etc. In a review of Soviet contributions to the development of lasers, the following is mentioned: In 1940, V. A. Fabrikant predicted theoretically the possibility of stimulated emission. In 1951, Fabrikant with M. M. Vudynskiy and F. A. Butayeva laid down the theory of the amplification of light and radio waves by means of an active medium to achieve stimulated emission. A year later, on the strength of that theory, N. G. Basov and A. M. Prokhorov in the USSR and Charles Townes in the United States simultaneously proposed the principle of the generation and amplification of electromagnetic radiation. In 1957, Basov, Prokhorov, and Yu. M. Popov developed the construction principles of optical masers and amplifiers, and in 1960 the first Soviet ruby laser was in operation. In that year, Basov and Prokhorov won Lenin prizes

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and in 1964 they shared the Nobel Prize for physics with Townes.  
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## MORE POWERFUL THAN THE HYPERBOLOID

O. Andreyev

In Issue No. 7 of our 1964 journal, we printed an article by Engineer-Colonel V. Nadin, entitled "Quantum Generators." It aroused considerable interest among our readers. One of them - K. A. Nikolayev of Otradnyy in Kuybyshevskaya Oblast - asks, "Is this quantum generator not the 'death ray' which, supposedly, was discovered in Japan in the mid-thirties and reported in our press at that time, and to whom the priority of discovery belongs?"

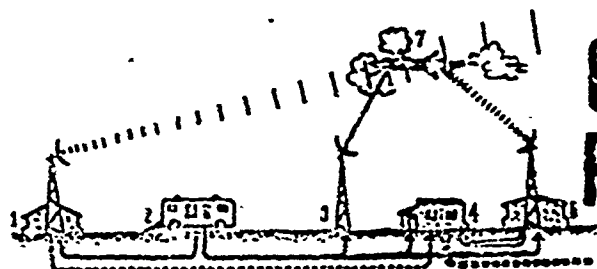
Let us answer these questions.

Before the war many articles were published in the Soviet press concerning discoveries in the field of military technology. Citing the foreign press, our newspapers and journals reported the appearance of mysterious rays, supposedly capable of killing people, setting fire to and destroying fighting equipment at a distance, stopping the motors of machines, burning up airplanes in flight, etc. In most reports they were called "death rays." Most frequently they were fantastic descriptions without any scientific basis. There also appeared articles which considered, more seriously, deadly weapons using a "heat ray."

Even in ancient times attempts were made to use heat rays for military purposes. There is a legend that Archimedes, who lived in 287 - 212 B.C., created "ray weapons" to protect his native city, Syracuse (Sicilian islands), from the Romans. If we believe the legend, Archimedes built a huge mirror on the coast and with it focused the sun's rays on Roman ships. In a short time they all burned.

It is known without doubt, that in the eighteenth century the outstanding physicist Bouffon, concentrated sun's rays by composite mirrors and burned various objects at a distance. Inventors in many countries picked up this idea. They suggested that armies be furnished their own sun projectors with which they could direct powerful streams of thermal energy at an enemy, burning and melting his equipment and personnel.

A concentration of sun rays is possible in the focus of a mirror. This means that the enemy must be in focusing distance. From a course in optics, we know that the radius of a mirror increases when focusing distance does. In order to direct focused rays a distance of even 1 km, we must construct a mirror of gigantic dimensions. But such an installation would be instantly destroyed by enemy fire.



**GRAPHIC NOT  
REPRODUCIBLE**

Diagram of anti-missile defense with quantum generators:

- 1 - radar station; 2 - power source; 3 - quantum generator with automatic ray-focusing device; 4 - control equipment;
- 5 - signals from the radar station which detected target earlier; 6 - precision target-tracking quantum generator;
- 7 - target.

Now it is easy to send out an invisible beam of rays. All we need is a filter which will absorb the visible rays and send out only the most effective, infra-red part of the energy. Such rays cannot be seen by the naked eye; however, they are easily detected with the aid of special instruments.

In 1936, the German physicist Noording, proposed a new idea; that a gigantic mirror made of light-weight and thin metal plates be carried to the stratosphere by rocket. Then the sun rays could be focused on an enemy on earth or in the air, to burn him. This suggestion also was unrealistic. The sun emits a stream of radiant energy of only two calories a minute per square centimeter. In order to burn even such easily inflammable material as dry wood, a temperature of 500-700 degrees is required. For this it is necessary to increase the energy of sun rays 20-40 times. Warming up the wood takes tens of minutes. To ignite wood instantaneously, solar energy would have to be increased a thousand times.

All this attests to the fact that it would be unrealistic to use solar energy for a "death ray."

Electromagnetic fields, supposedly capable of destroying enemy military equipment and personnel, have also been reported in our press. It is known from physics that metal objects, which exist within an electromagnetic field, get warm. However, in order to melt such objects or to ignite them instantaneously, would require sources of electrical energy of fantastic power. As yet, it is difficult to say what effect the electromagnetic field has on people, although research in the field has been conducted in our country and elsewhere.

Often mentioned in articles of that time were "death rays" similar to those described by A. N. Tolstoy in "The Hyperboloid by Engineer Garin." In this novel, Engineer Garin destroyed armored ships with a thin ray of light with colossal power, at a distance of several kilometers. In the description of the hyperboloid, A. N. Tolstoy used the idea of concentrating the random thermal energy of incandescent atoms. Such an idea is hopeless, because it would require the concentration of energy from a countless number of suns.

The physical basis for quantum generators is completely different: inductive (stimulated), and not thermal radiation.

Quantum generators were first discussed for military use in 1961. Forty-nine of the leading American specialists in radicelectronics were asked: "What research in this field should be considered the most important?" They answered unanimously: the development of optical lasers\*. These specialists believed that if they could manage to develop a method of focusing great energy at a considerable distance, they could solve many problems of science and technology, military problems in particular, such as knocking down inter-continental rockets.

In 1962 the American aviation journal, "Aviation Week" published an article entitled, "USA Begins Laser Armament Program." It mentioned that this equipment will use beams of electromagnetic radiation of extremely high energy generated by lasers which then become "death rays," again alluding to science fiction. Other countries are also doing considerable work in this field - England, France, Italy, Switzerland, the German Federal Republic, and Japan.

Judging by foreign publications, optical quantum generators (lasers) can accomplish multichannel noiseproof communication, guide missiles, rockets, and spacecraft to target, detect cosmic and other targets, track them in flight, etc. The greatest attention has been given to making "ray weapons" based upon the destructive characteristics of powerful lasers, such as their high temperature and specific density of radiation energy. Some articles have indicated that the United States has built a laser capable of creating a temperature of nearly one million degrees on the surface of the irradiated object. The ray is focused on a spot one centimeter in diameter. Because of this, the laser is proposed as the basis of an on-board armament system with a range of 64 to 320 km at altitudes above 30 km. Furthermore, the press has indicated that experimental models of such armament will be produced by 1970.

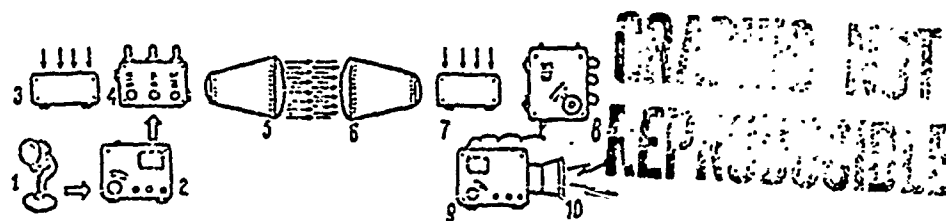
Of course, almost any scientific achievement can be used for military purposes. Because of this, the American professor A. Valentin has said, figuratively, "When science makes a discovery, the devil siezes it right away, while angels discuss its best use."

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\* In Western countries, quantum generators and amplifiers are called masers, based on the first letters of the English words meaning microwave amplification by stimulated emission of radiation. Laser means light amplification by stimulated emission of radiation.

Soviet scientists demonstrate the best uses of this discovery. In our country, crystal, gas and semiconductor quantum generators and amplifiers have been made. Their use is already bringing about significant changes in many fields of science and technology. They are making it possible to solve many complex problems which not long ago were considered insoluble. Quantum instruments allow us to pick up extremely weak signals reaching earth from the most distant galaxies. With them, we can construct multichannel communications systems to transmit information for distances so great they cannot be measured by linear quantities known to man (distances in tens of light years, and light travels 300,000 km/sec.). Along such a "communications line" can be sent billions of telephone conversations or hundreds of thousands of television programs.

Beams from quantum generators can create temperatures in the millions of degrees. They make it possible to vaporize the most infusible substances and to process extremely hard materials such as diamonds. These instruments will be widely used for the study of plasma, the verification of the theory of relativity, in metallurgy, location, biology, and medicine. The first eye surgery using quantum generators has been performed in our country. These instruments can "probe" the surface of planets and draw up relief maps, which until now would have been considered fantastic.



A communications layout using lasers (left - transmitter; right - receiver:

- 1 - microphone; 2 - low frequency amplifier; 3 - optical quantum generator; 4 - modulator; 5 - transmitting optical system;
- 6 - receiving optical system; 7 - optical quantum amplifier;
- 8 - photodetector-demodulator; 9 - low frequency amplifier;
- 10 - speaker.

Who was first in developing quantum generators?

Soviet scientists have made a great contribution to this field of science. As early as 1940, the Soviet physicist V. A. Fabrikant laid the theoretical basis for producing experimentally the stimulated emission of radiation. In 1951, along with M. M. Budynskiy and F. A. Butayeva, he presented briefly the theory of light and radiowave amplification by means of creating an active medium and obtaining the stimulated emission of radiation. A year later, on the basis of this theory, Soviet physicists H. G. Basov and A. M. Prokhorov and, at the same time, American physicist C. Townes, J. Gordon and H. Zeiger proposed the principle of generation and amplification of electromagnetic radiation. Five years after that, N. G. Basov, B. M. Vul, and Yu. M. Popov developed the construction principles for quantum generators and amplifiers in the range of visible light.



In 1960, the first ruby quantum generator was already operating. In that same year, N. G. Basov and A. M. Prokhorov were presented with the Lenin prize for their outstanding achievements in this field. The work of these Soviet scientists and the American physicist C. Townes, has led to a genuine revolution in quantum physics and electronics. Last year, the Swedish Academy of Science awarded them the Nobel Prize in Physics for 1964. It is considered that they achieved this outstanding discovery simultaneously and independently.

Thus, that which not long ago, in the mid-thirties, was considered fantastic, is not an actual fact.